MULLARD RADIO VALVE CO.

PARAMETRIC AMPLIFIER

TYPE CL 9012

MP MASTER
MA23734

THE MULLARD RADIO VALVE COMPANY.
MITCHAM.

PARAMETRIC AMPLIFIER

TYPE CL 9012

Instruction manual for parametric amplifier assembly type CL 9012

Serial No: 58

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Description of System.

The Cl 9012 consists of:

(a) Parametric Amplifier complete with diode type CAY 10.

(b) Circulator.

(c) Pump Klystron type KS9-40P

An outline drawing of the assembled unit is shown in Fig.1 indicating "signal IN" to port 1 and "signal OUT" from port 3 of the circulator; these are in 50 ohms type N coax.

Gain is set by adjusting the waveguide attenuator integral with the paramp body, the adjustment being effected by means of a hexagonal key attached to the body. A clockwise rotation of the key decreases the gain.

Frequency of operation is set by means of the micrometer head, a clockwise rotation corresponding to an increase in frequency. A calibration chart is provided in Fig. 2.

N.B. The gain and frequency controls are the only adjustments necessary on the CL 9012 assembly. The klystron frequency has been set at the factory to 9.500 GHz and the three pump matching screws adjusted to suit, further adjustments to these being unnecessary.

Power Requirements.

The assembly does NOT include a pump klystron power supply. Because of the stringent requirements of the power supply with regard to regulation, stability and ripple, the WE40 (6.3V heaters) as supplied by Microwave Instruments Ltd., is recommended.

IMPORTANT.

The WE40 is supplied with a link between the cathode rail and the centre tap of the klystron heater transformer. This link MUST be removed and replaced by a 10 k ohms, 1 watt resistor before connecting to the klystron.

The KS9-40P klystron is set to operate at a frequency of 9.500 GHz (see data sheet Fig.3) and requires the following electrode voltages:

Heater 6.3V, 500mA.

Resonator 300V, 33mA.

Reflector -80v to -120v.

Performance.

(Diode stk 0291)

At 20dB gain.

Signal Frequency (GHz)	Micrometer Reading	3dB Bandwidth (MHz)	Noise Figure (dB)
2.7	1·08	14	2·8
2.8	1·26	14	2·8
2.9	1·39	15	3·0
3.0	1·65	13	2·9
3.1	2·25	12	3·0

Signal power at input to compress gain by 1dB = - 35dB mW approx.

Setting-up Procedure.

The setting-up procedure given below is sub-divided into two parts. Firstly two methods are given whereby the pump klystron can be properly set, secondly two methods are given for setting the amplifier gain and frequency.

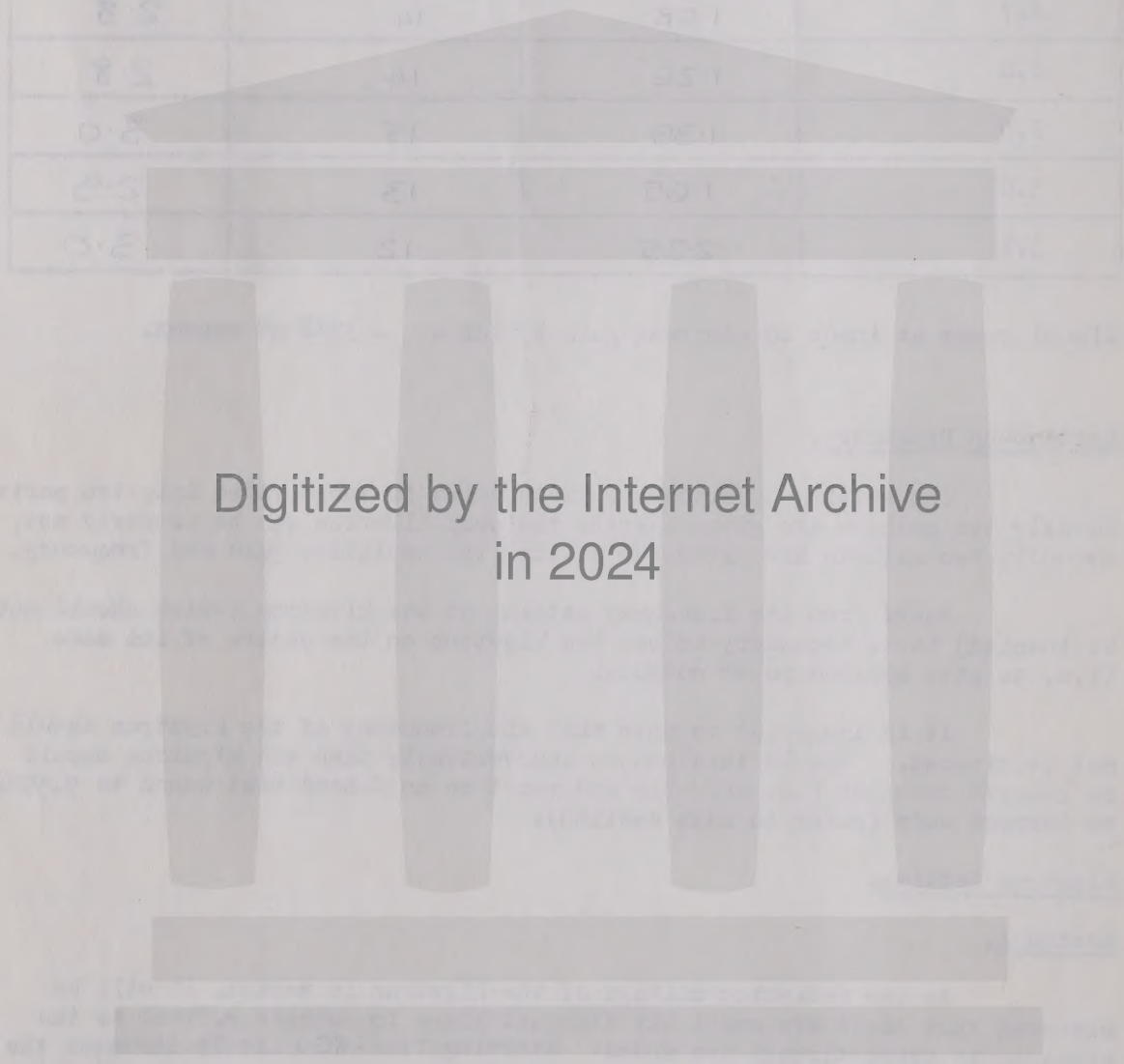
Apart from the frequency setting of the klystron (which should not be touched) it is necessary to set the klystron on the centre of its mode (i.e. to give maximum power output).

It is important to note that the frequency of the klystron should not be altered. Should this happen inadvertently then the klystron should be removed from the P.A. assembly and reset on an X-band test bench to 9.5GHz on correct mode (refer to next section).

Klystron Setting.

Method 1.

As the reflector voltage of the klystron is varied, it will be observed that there are small but distinct rises in cathode current as the klystron is swept through its modes. Starting from -80v slowly increase the reflector voltage through to -120v. Select the mode giving maximum power out (corresponding to the greatest rise in current) and adjust carefully to get the highest value of cathode current possible on that mode. Now lock the reflector voltage knob.



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Method 2.

(a) Place a millivoltmeter (100mV F.S.D.) across port 1 of the circulator (between the earthed outer and the inner pin).

(b) Set the tuner micrometer on the P.A. to the setting for 2.80 GHz (Fig.2)

(c) Wind out the pump attenuator (i.e. fully anti-clockwise)

(d) Adjust pump klystron reflector voltage for maximum output on the millivoltmeter, between -80v and -120v reflector setting.

(e) Lock the reflector voltage knob.

(f) Wind in the pump attenuator (clockwise) by three or four turns.

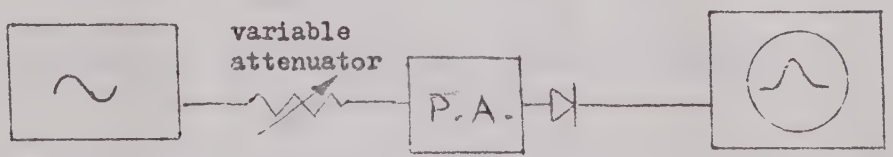
The klystron is now set and should not be adjusted except for normal cabin maintenance.

This operation should be carried out after the klystron has had time to reach a steady operating temperature (usually 10-15 minutes).

Paramp Gain Setting.

Method 1.

This method uses a signal source which may be either single frequency or swept frequency, the latter being easier.



(a) Adjust tuning micrometer to reading necessary for correct signal frequency (see chart in Fig.2)

(b) Wind gain adjusting screw fully in with hexagonal key.

(c) Set variable attenuator to provide $\leq$ - 20dB mW at paramp input.

(d) Note output level on 'scope or meter'.

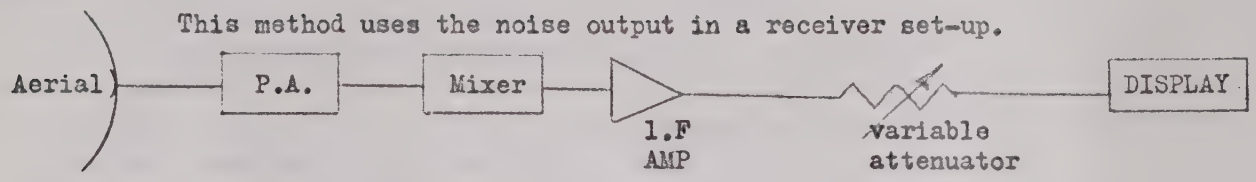
(e) Add 23dB to attenuator reading.

(f) Wind out gain attenuator slowly until same output level as in (d) is obtained.

(g) Adjust frequency slightly if necessary.

Method 2.

This method uses the noise output in a receiver set-up.



(a) Replace the aerial with a matched load.

(b) Set the paramp to the required frequency using the micrometer tuning control in conjunction with the chart in Fig.2.

(c) With the paramp "OFF", i.e. gain control "IN", note the amplitude reading on the display ------ R_1

(d) With the paramp "ON" note the display reading ------ R_2.

The gain is given by:

$$G = \frac{R_1}{R_2} \cdot \frac{F_m}{F_a}$$

G = gain

F_m = noise figure of mixer

F_a = " " " paramp with mixer.

If $\frac{R_1}{R_2}$ is express as a ratio in dB = RdB

then , $G = R + F_m - F_a$ dB

Typically $F_m \simeq$ 10dB (consult equipment handbook)

$F_a \simeq$ 3dB

$\therefore$ For 20dB gain R = 13 dB.

In general it is more convenient to set the gain to a known level (20dB recommended), for this purpose it is possible to make up an I.F attenuator of value "R" ($R=G-F_m + F_a$), thus the gain setting is carried out at a constant detector level.

Finally check that the paramp is at the correct frequency by sweeping the L.O slowly from side to side and looking for a maximum.

Maintenance.

Because the CL9012 has only two active elements the maintenance required is minimal. The possible causes of failure are as follows:

(a) The varactor diode may become open or short circuit due to an overload.

(b) A gradual deterioration of the varactor diode may occur due to high leakage from a transmitter.

(c) A gradual or catastrophic failure of the pump klystron.

(d) A failure of the klystron power supply.

In addition to the above causes of failure it is possible that slow variations of the klystron power output will take place. In order to guard against this, the klystron and paramp should be reset weekly as part of a regular maintenance schedule.

IMPORTANT.

The klystron tuning screws and pump matching screws are set by the manufacturers using complex test equipment. NO ATTEMPT TO ADJUST THESE SCREWS SHOULD BE MADE BY MAINTENANCE STAFF.

Diode Check/Replacement.

If diode failure is suspected then the following procedure should be followed:

(a) Unscrew diode clamp protective cap.

(b) Remove diode clamping screw.

(c) Remove diode with tweezers.

(d) Measure d.c. resistance both ways using low voltage ohm-meter (6V max). If the resistances differ greatly from nominal values of 500kΩ/5kΩ resp. replace diode.

(e) Slowly screw in diode clamping screw to a torque of 20-25 oz-ins.

(f) Replace diode clamp protective cap.

(g) Reset paramp as in "setting-up" procedure.

Klystron Replacement.

(a) Disconnect the base and top cap and unsolder lead from body.

(b) Unbolt the 4 retaining nuts and bolts and withdraw old klystron.

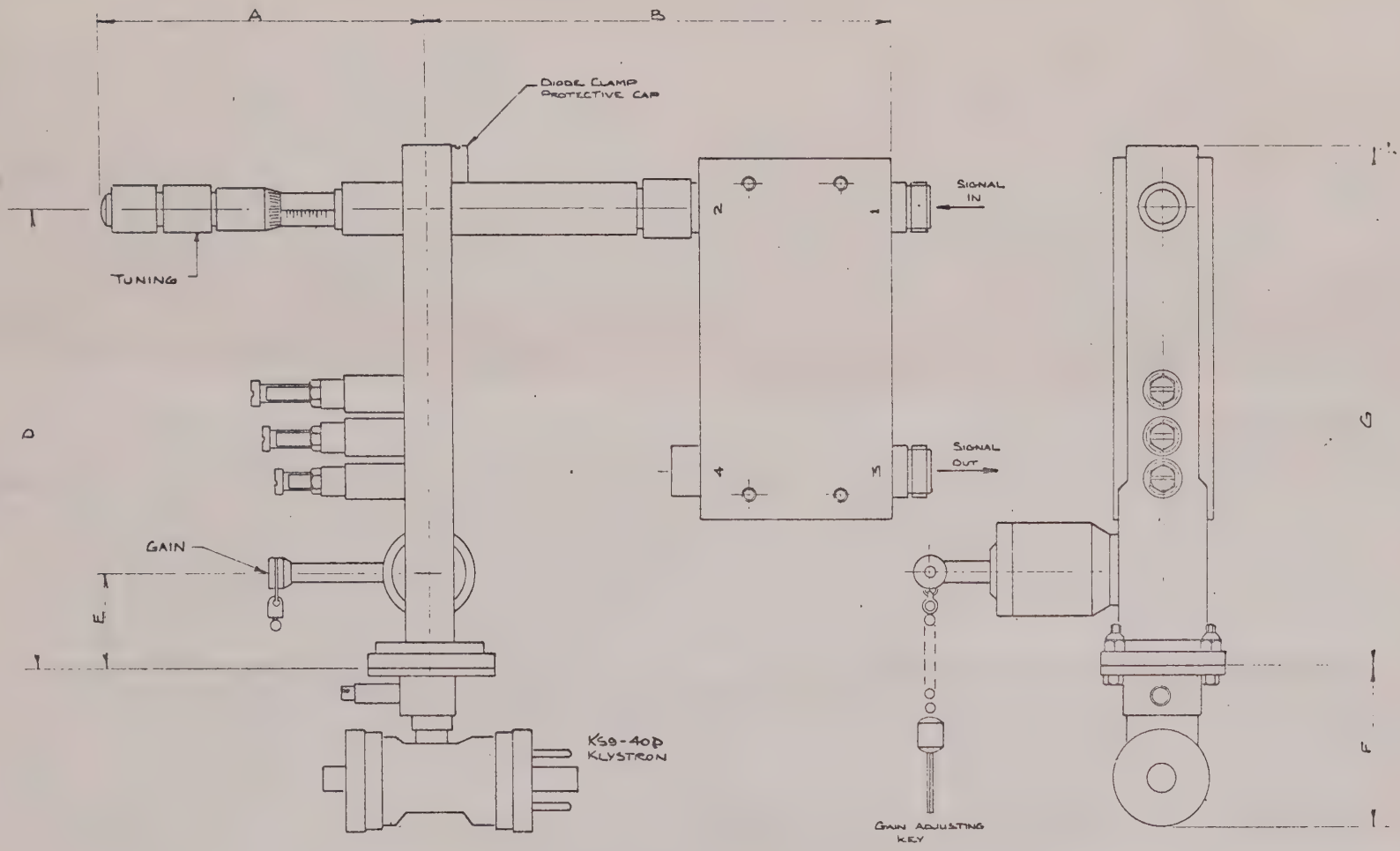
(c) Bolt in new klystron.

(d) Reconnect the base and top cap and resolder lead to body.

(e) Reset klystron according to section on "klystron setting-up".

NOTE: The klystron must be replaced by one having the same frequency as the original one i.e. 9,500 GHz.

APT/JM
15.1.69.

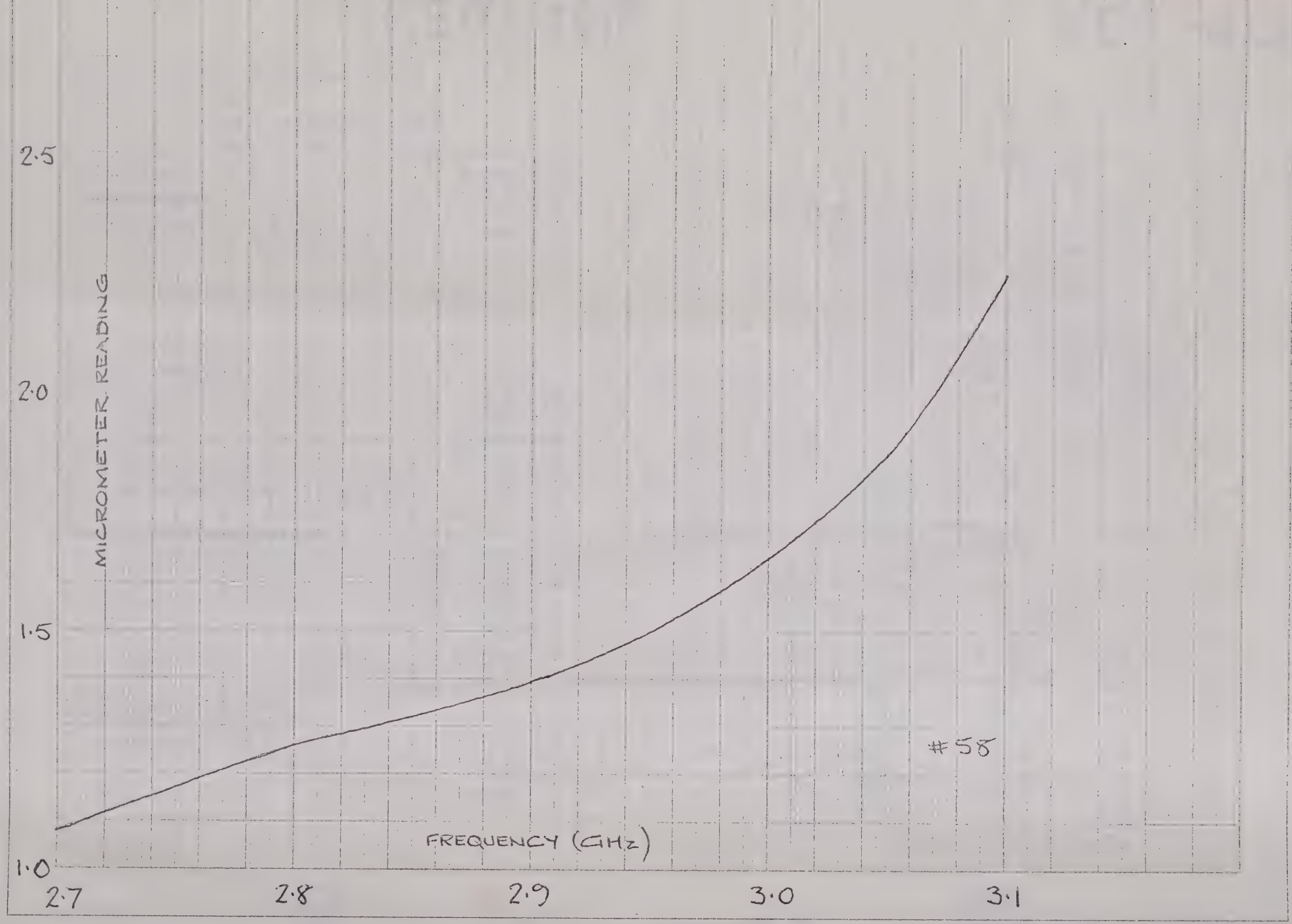


DIMN	MAX	MIN	DIMN	MAX	MIN
A	1180		F	540	
B	1510		G	1675	1665
C	765	759			
D	1476	1471			
E	314	306			

TOTAL REQUIRED	QUANT	DESCRIPTION	CODE No.	FORM STANDARD REMARKS	POS
THE ANGLE PROJ.		SCALE	DIMENSIONS mm	TOLERANCES unless otherwise stated	
MATERIAL			FINISH		

PARAMETRIC AMPLIFIER
CL9010 OUTLINE

8213 031 0674


MICROMETER READING
2·5
2·0
1·5
1·0
2·7
2·8
2·9
3·0
3·1
FREQUENCY (GHz)
#58

KS9-40P

PRELIMINARY DATA

QUICK REFERENCE DATA

Light-weight mechanically tunable klystron for local oscillator applications.

Frequency	9.500	Gc/s
Power output	40	mW
Construction	Waveguide output with coupled cavity	

TYPICAL OPERATION

f	9.5	Gc/s
$V_{resonator}$	300	V
$I_{resonator}$	33	mA
$V_{reflector}$	−100	V
P_{out}	40	mW
Electronic tuning range between half-power points	40	Mc/s

ABSOLUTE MAXIMUM RATINGS

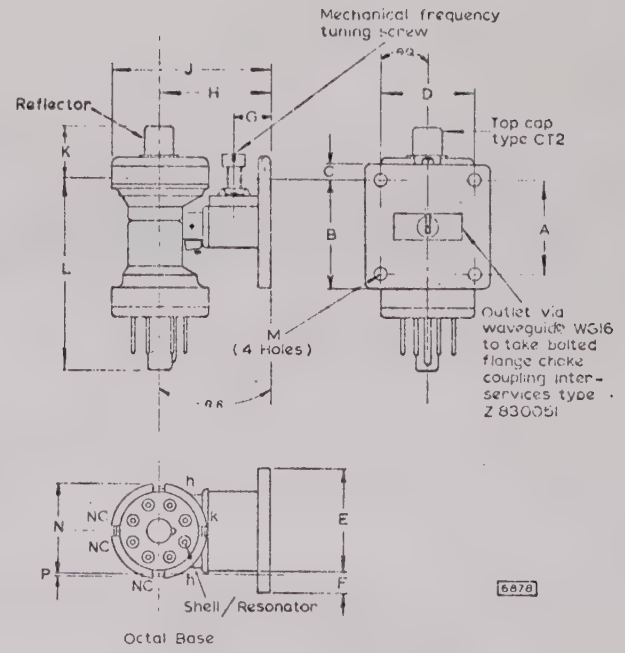
	Min.	Max.	
$V_{resonator}$	—	300	V
$I_{resonator}$	—	40	mA
$V_{reflector}$	−80	−120	V
$Z_{reflector\ supply}$	—	100	kΩ
V_{h-k}	—	±50	V
T_{shell}	—	150	°C
v.s.w.r.		1.5	

CATHODE

Indirectly heated

V_h	6.3	V
I_h	500	mA
t_{h-k}	60	s

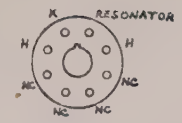
KS9-40P



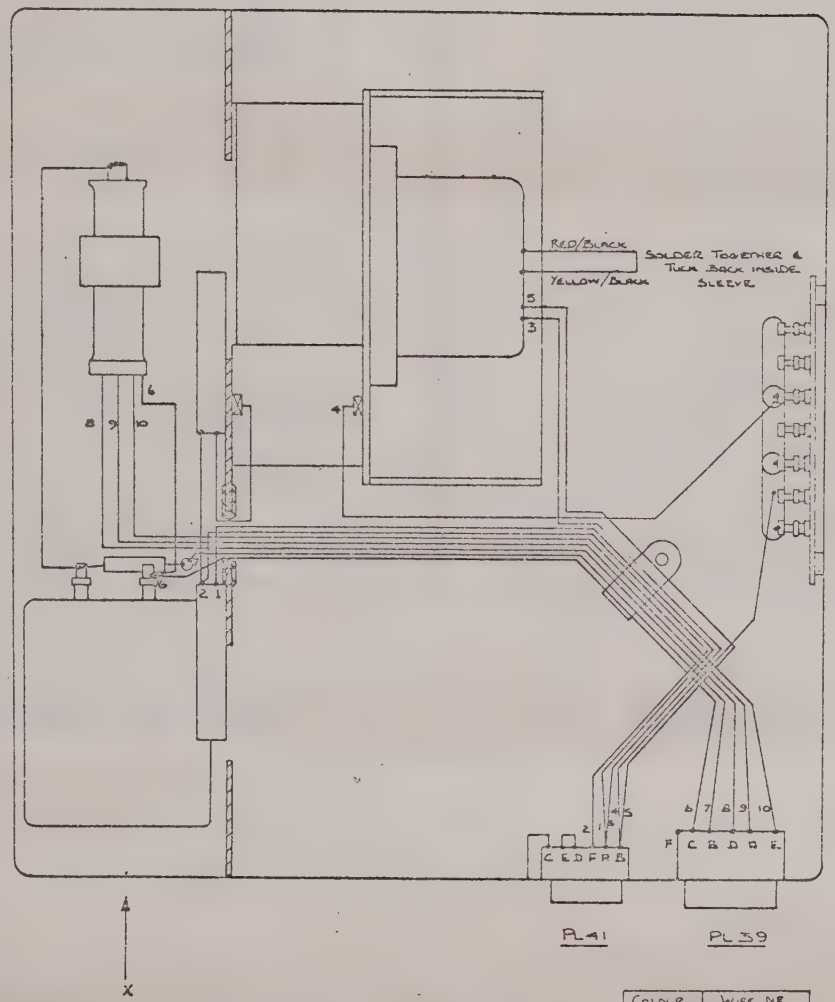
Octal Base

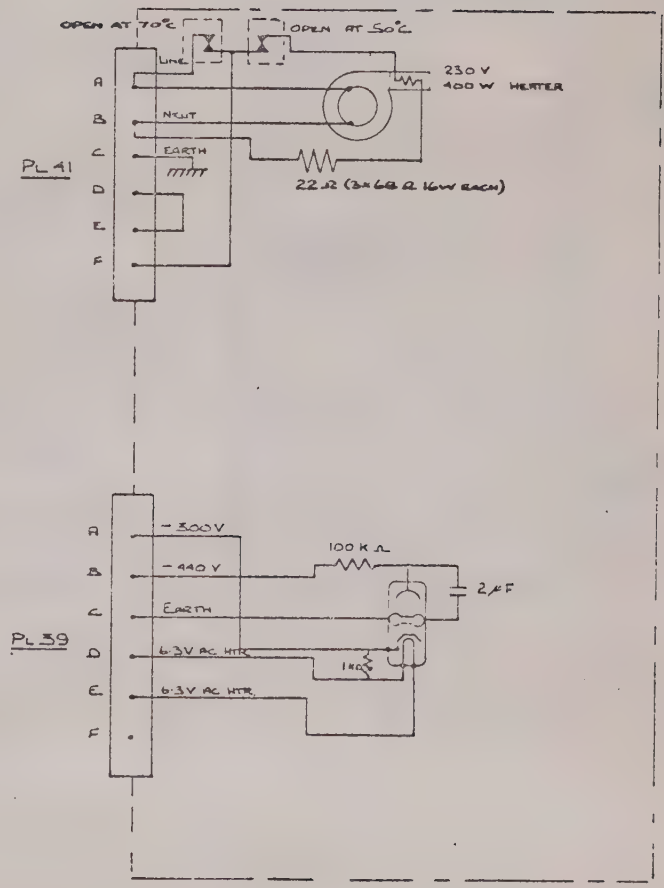
DIMENSIONS

	Inches	Millimetres	
A	1.282 ± 0.004	32.54 ± 0.1	
B	1.461	37.10	max.
C	0.177	4.50	max.
D	1.220 ± 0.004	30.97 ± 0.1	
E	1.429	36.30	max.
F	0.209	5.30	max.
G	0.354 ± 0.039	9 ± 1	
H	1.437 ± 0.099	36.5 ± 2.5	
J	2.126	54	max.
K	0.866	22	max.
L	2.520	64	max.
M	0.168 ± 0.003	4.275 ± 0.075	
N	1.280	32.5	max.
P	0.059	1.5	max.
∠Q		1°	max.
∠R		1°	max.



VIEW OF VALVE IN DIRECTION X





COLOUR	WIRE NR
RED	6 3
YELLOW	7 5
BLUE	8
GREEN	10
BLACK	9
ORANGE	1 2 4

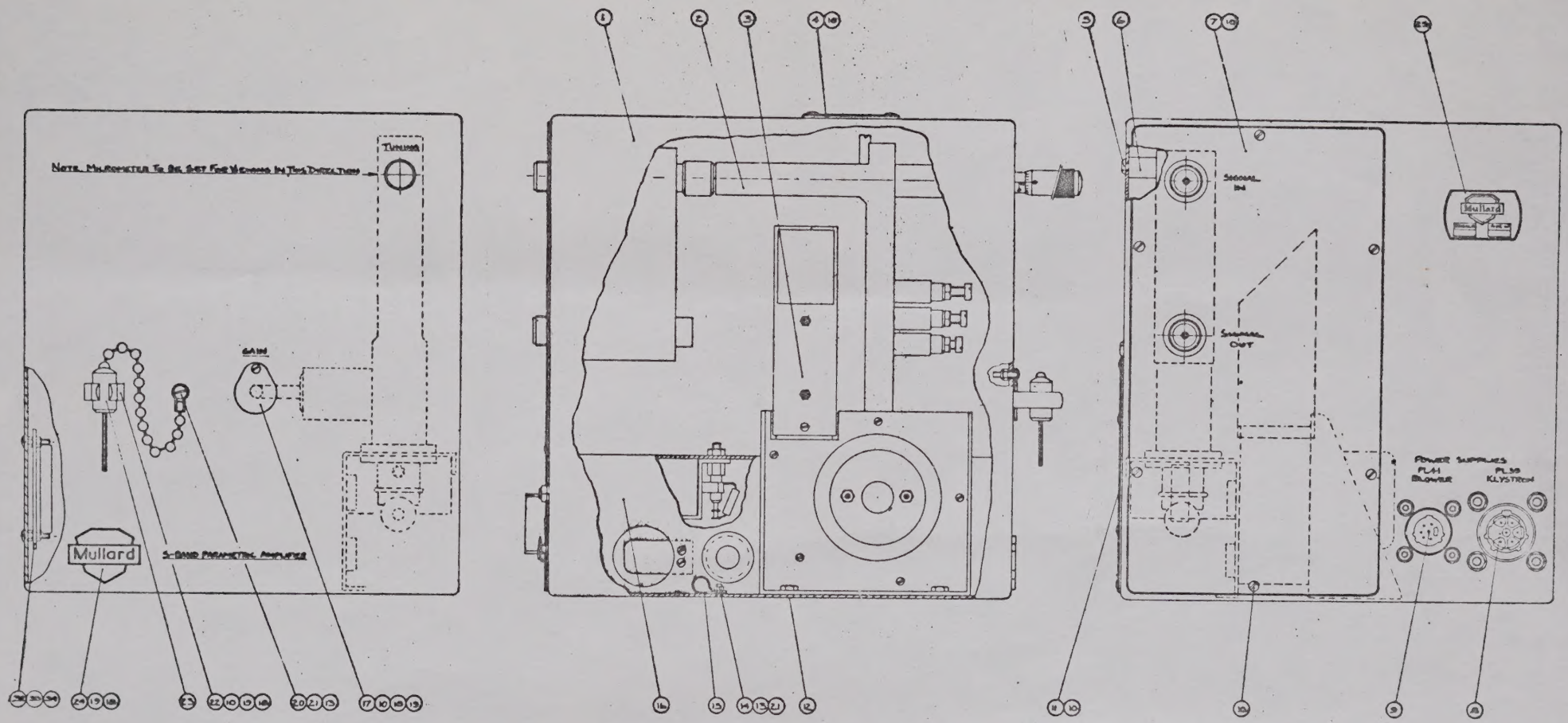
TOTAL QUANT	QUANT	DESCRIPTION	CODE No.	FSCM STANDARD REMARKS
ANGLE PROJ		SCALE	DIMENSIONS mm	TOLERANCES unless otherwise stated
MATERIAL		FINISH		SURFACE FITS TO FINISH

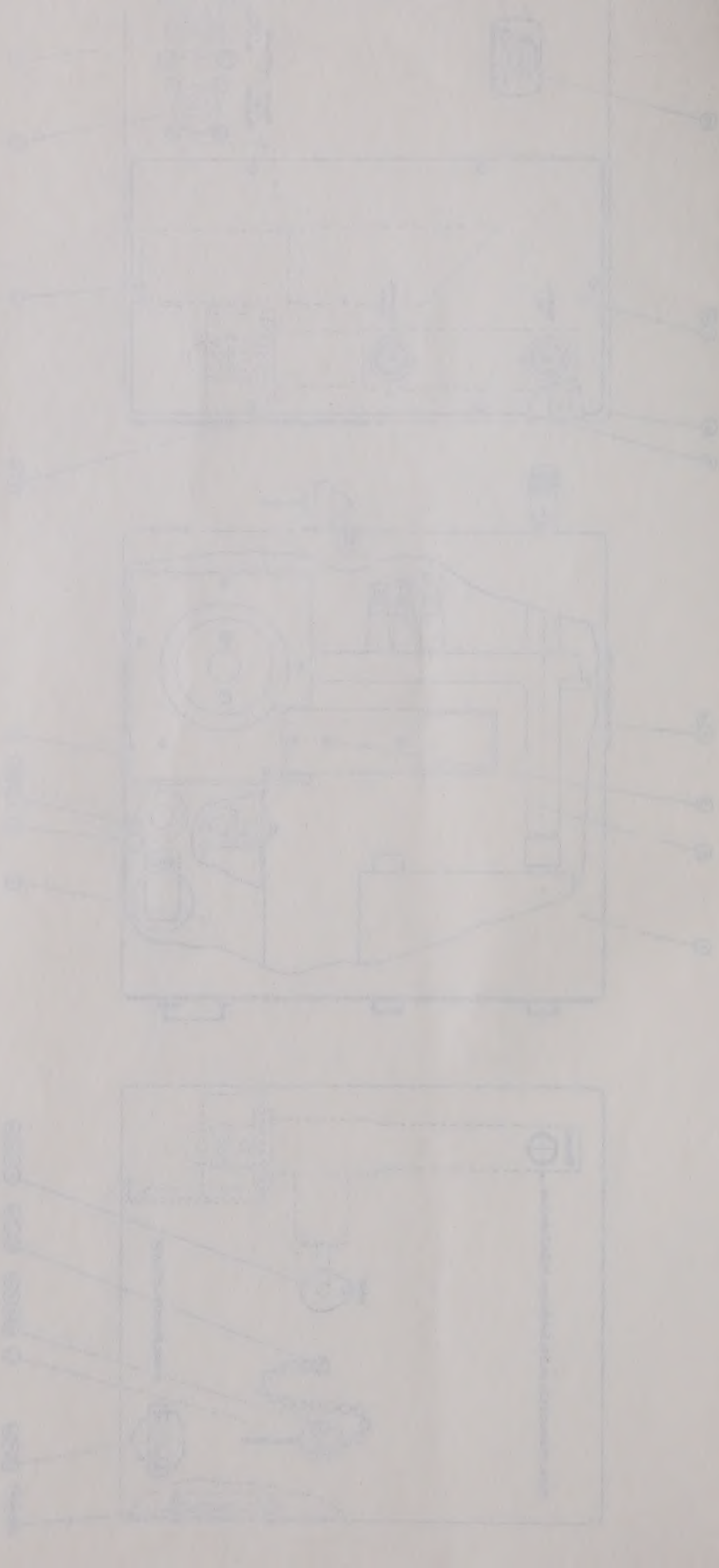
WIRING DIAGRAM
(KS9-40B) C6 9012

8213 031 0032

NAME SUPERSEDES 8213 031 00662 DATED

THE MULLARD RADIO VALVE Co MULLARD Ltd NEW Rd MITCHAM Inc SURREY


NOTE. MILLIOMETER TO BE SET FOR WORKING IN THIS DIRECTION
TUNING
GAIN
Mullard
S-BAND PARAMETRIC AMPLIFIER
SIGNAL IN
SIGNAL OUT
Mullard
POWER SUPPLIES
FL41 BLOWER
FL30 KLYSTRON



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